Multi-resolution investigation of smoke observations: the value added by datasets at high spatial resolutions

Huikyo Lee (huikyo.lee@jpl.nasa.gov), Jet Propulsion Laboratory, California Institute of Technology, USA.

Under greenhouse warming, extreme weather conditions that favor wildfire ignition are expected to occur more frequently at many locations around the world. For example, Amazon rainforest fires were exceptionally severe in both 2019 and 2020. These Large-scale wildfires fueled by hotter and drier weather conditions can cause irreversible environmental damage, via massive emissions of smoke aerosols that can significantly affect climate and air quality. NASA's satellite and airborne observations have provided comprehensive observations of aerosol plumes from wildfires. As the algorithms to retrieve aerosol optical depth (AOD) are more advanced, aerosol observations with finer spatial resolutions are available via NASA's Earth Science Data Systems (ESDS). Not surprisingly, expenses of archiving and distributing datasets at higher spatial resolutions have risen. The challenge here is to demonstrate the value added by newer versions of datasets at higher spatial resolutions compared to their previous versions. Using the AOD observations from the Multi-angle Imaging SpectroRadiometer (MISR) instrument, I investigated the spatial variability of smoke aerosols over South America. Jet Propulsion Laboratory's Hierarchical Equal Area isoLatitude Pixelization (HEALPix) offers capabilities that can decompose spatial variability in MISR AOD at 4.4 km resolution. As a methodology for discretizing multi-resolution spherical data, HEALPix facilitates multi-resolution investigation of any datasets on a map. Multi-resolution investigation is to analyze spatial features at coarse (e.g. 100 km) and fine scales (spatial scales of around 10 km or smaller) separately. The case study during Amazon rainforest fires indicate that it is important to provide AOD observations at 4.4 km. At coarser resolutions than 10 km, AOD maps over the region do not represent the fine-scale variability in AOD. The multi-resolution investigation of existing AOD datasets can provide an answer to the following question: How high spatial resolution of AOD should the next suborbital/satellite missions provide?